Scutellinia (Pezizales) In Korea, With A New Species and Eight New Records

Scutellinia (Pezizales) in Korea, with a new species and eight new records

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With 2 figures

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Abstract: Eleven species of the genus *Scutellinia* (Pyronemataceae, Pezizales) are recognized in Korea by analysis of macro- and micro-morphological characteristics, substrates and geographical distributions. Eight species are recorded new to Korea, namely, *S. ahmadiopsis*, *S. badio-berbis*, *S. colensoi*, *S. jilinensis*, *S. nigrohirtula*, *S. olivascens*, *S. setosa* and *S. patagonica*. Based on the exceptional length of marginal hairs and tuberculate ascospore wall ornamentation, two Korean specimens occurring on wood are described as a new species. Infraspecific morphological variations among collections within *S. scutellata* and *S. patagonica* were found. These are tentative treat as species complexes. The highly questionable occurrence of *S. setosa* in Asia was confirmed. Descriptions and taxonomic notes of the recognized species of *Scutellinia* are provided with a taxonomic key, illustrations and photographs of these species from Korea.

Keywords: Ascomycete, East Asia, *Scutellinia erinaceus*, *S. kerguelensis*, *S. umbrarum*, wall ornamentation

Introduction

The genus *Scutellinia* (Cooke) Lambotte is one of the genera with the most species in the Pyronemataceae (Pezizales, Ascomycota). Cooke (1879) first employed the name *Scutellinia* as a subgenus of *Peziza*; it was elevated to generic rank by Lambotte (1887). The name *Scutellinia* has a confusing history; many earlier authors used the names *Patella* F.H.Wigg., *Ciliaria* Quél. ex Boud. or *Lachnea* (Fr.) Gillet for these species. Applying a narrow generic concept Le Gal (1953) adopted the name *Scutellinia* instead of the invalid *Ciliaria* that had been favored by many workers. Her restricted concept has been widely adopted in the taxonomic literature (Korf & Schumacher 1986, Schumacher 1990 and citations referred therein). This cosmopolitan genus is easily recognized by its shield-like red or orange apothecia, globose to ellipsoidal ascospores with or without various wall ornamentations, and stiff, long, blackish-brown hairs that arise from inner cells of the ectal excipulum. In considering the delimitation of species morphological characters were used as well habitat information and geographic distribution. Among the characters that have previously been used in defining species, hair morphology and ascospore shape and ornamentation have been especially emphasized in most keys at the infrageneric and species level (Bogacheva & Kullman 2006, Donadini 1983, Gamundí 1956, 1975, Hansen & Knudsen 2000, Kullman 1982, Le Gal 1972, 1974, Mato
ec 2000, Moravec 1974, Schumacher 1979, 1990, Svrček 1971). Two different types of hairs were distinguished in *Scutellinia* species. Schumacher (1990) termed them “marginal hairs,” those at or near the margin of apothecia, and “lateral hairs,” those on the receptacle lower down. In some *Scutellinia* species, the marginal hairs are longer and broader than lateral hairs and have extensively forked or divided bases. Kullman (1982) and Schumacher (1990) referred to the hairs as “differentiated” when marginal and lateral hairs could easily be distinguished from one another and as “not differentiated” when they were too similar to discriminate. We follow their terminology in our descriptions.

Despite considerable taxonomic study of the genus, species delimitation and infrageneric subdivision within *Scutellinia* have remained problematic. Molecular phylogenetic approaches have been applied at the species level to other members of the Pyronemataceae, e.g. *Otidea* (Pers.) Bonord. (Liu & Zhuang 2006), *Chaetothiersia* Perry & Pfister (Perry & Pfister 2008) and *Geopora* Harkn. (Tamm et al. 2010), but only a scattering of species of *Scutellinia* have been included in larger level studies (Perry et al. 2007). As a component of our broader work we have undertaken a molecular phylogenetic study and although this is not presented here in this regional mycota, it has helped to inform our decisions on the delimitation of species. The phylogeny will be presented as part of a larger study.

Among the approximately 50 species recognized in *Scutellinia* (Schumacher 1988, 1990) four species have been recorded from Korea prior to work by the present authors: *S. erinaceus* (Schwein.) Kuntze (Cho & Lee 2002), *S. kerguelensis* (Berk.) Kuntze (Park et al. 1994, Jung 1995), *S. scutellata* (L.) Lambotte (Lee & Cho 1975, Jung 1995) and *S. umbrorum* (Fr.) Lambotte (Cho et al. 1997). Cho et al. (1997) had reported *S. pseudoumbrarum* J.Moravec, but this species is now considered a synonym of *S. umbrorum* (see Schumacher 1990). Only in the case of *S. kerguelensis* and *S. scutellata* (Jung 1995) did these earlier workers provide detailed information on morphological characters, such as shape and size of hairs and wall ornamentation of ascospores. Such features are important in identifying species; records that lack such information are considered questionable.

From 2001 to 2008 fieldwork was conducted in South Korea with a specific emphasis on the cup-fungi. Many *Scutellinia* specimens were collected from around the country by the first three authors. The main objective of this study is to document the *Scutellinia* species in Korea based on these extensive collections. Descriptions, taxonomic and a key are included.

Materials and methods

About one hundred *Scutellinia* specimens collected between 2001 and 2008 were examined and identified. Specimens were collected from many locations throughout South Korea. These were studied in fresh condition to observe color and macroscopic features and dried condition, primarily to observe and measure structures. Specimens are deposited in the Fungal Herbarium of Korea University (KUS-F). Microscopic examination was made from hand-free sections in water or 3% KOH and subsequently stained in Lactofuchsin or Cotton Blue in lactic acid. Measurements were performed at 1000× for ascospores and at 100-400× for other structures. Size of ascospores are reported as maxima and minima in parentheses, and the mean plus and minus for the standard deviation of 50 matured spores.

To observe spore wall ornamentation Scanning Electron Microscopy (SEM) was performed on the following species: *S. ahmadiopsis* W.Y.Zhuang, *S. badio-berbis* (Berk. ex Cooke) Kuntze*, S. colensoi* Massee ex LeGal*, S. olivascens* (Cooke) Kuntze*, S. scutellata* and *S. patagonica* (Rehm) Gamundí. The quality of available material precluded *S. jejuensis* J.G.Han, Y.J.Choi & H.D.Shin, *S. jilinensis* Z.H.Yu & W.Y.Zhaung, *S. nigrohirtula* (Svr
ek) LeGal and *S. setosa* (Nees) Kuntze from SEM study. For SEM specimen holders with double-sided adhesive tape were placed in the middle of a Petri dish bottom that was lined with wet filter paper. Apothecia were hung upside down above the holders at the middle of a Petri dish cover. The Petri dish was sealed with Parafilm and incubated at 18°C for one or two days. After air-drying, the ascospores were coated with platinum with a Hitachi E-1010 ion sputter. The surface structure of spores was observed at 18 kV and photographed with a Hitachi S-3500N scanning electron microscope.

In the treatment that follows recognized species are arranged alphabetically. New records from Korea are marked with an asterisk (*).

Taxonomy

* ***Scutellinia ahmadiopsis*** W.Y.Zhuang, Fung. Diversity 18: 216 (2005) (FIGS. 1 A-D)

APOTHECIA sessile, 3–8(–15) mm diam, discoid, disc irregularly undulate to round, with an indistinct margin covered by very short, pale brown hairs; hymenium orange or dull orange when fresh. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 20–80 µm diam, hyaline to subhyaline, elongated toward the margin. MEDULLARY EXCIPULUM of *textura intricata*, hyaline. SUBHYMENIUM indistinct. HAIRS not differentiated, pale brown, mostly ventricose, slightly bent, 100–320 µm long, 10–22 µm wide, 2–6 septate, walls thick up to 3–5 µm, apex pointed or sometimes obtuse, bases simple or bifurcate. ASCI hyaline, cylindric, 8–spored, 190–255 × 14–20 µm, apex rounded, about two thirds occupied with ascospores. ASCOSPORES ellipsoid to broadly ellipsoidal, (18.5–)19.6–21.8(–23.5) (av. 20.7) µm long, (11–)12.8–14.1(–14.5) (av. 13.5) µm wide, l/w ratio (1.35–)1.46–1.62(–1.70) (av. 1.54), containing mostly one large guttule in dry material, but often two or many small guttules; wall ornamentation low and irregularly verrucose; warts irregular in shape and size, 0.3–1.2(–1.5) µm wide, 0.2–0.6 µm high, often interconnected; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 6–7 septate, 2–4 µm wide, not or branched 1–2 times in lower part, even with or slightly longer than the asci; apical cell clavate, 30–45 µm long, 6–10 µm wide.

Specimens examined. SOUTH KOREA: Pocheon, National Arboretum, 19 Jul 2001 (KUS-F50040); as above, 24 Aug 2001 (50171); Pyeongchang, Korea Botanic Garden, 6 Jun 2002 (50534, 50535); Chuncheon, Haekgol, 28 Jun 2002 (50560); Gangneung, Eoheul-ri, 1 Jul 2002 (50586); Hongcheon, Experimental Forest of Kangwon National University, 23 Sept 2005 (50874); Guri, Donggureung, 12 Oct 2007 (51938).

Habitat. On damp rotting woods, branches or twigs

Notes. Based on undifferentiated short marginal hair, ellipsoidal to broadly ellipsoidal ascospores and verrucose wall ornamentation, the present material agrees well with *S. ahmadiopsis* (Zhuang 2005), although marginal hairs are longer in the Korean specimens (up to 320 µm) than in its original description from China (up to 205 µm). A similar species with short marginal hairs and low warts, *S. hyalohirsuta* W.Y.Zhuang, has recently been introduced (Zhuang & Yang 2008), but this species could be distinguished from *S. ahmadiopsis* by broader ascospores (14.7–17.6 µm) and more finely warted ascospore. Many morphological characteristics of this species are similar to *S. superba* (Velen.) LeGal that is recorded mainly from Europe. But, *S. ahmadiopsis* possesses spore walls that do not loosen in heated lactic acid; a clearly loosened wall is present in *S. superba*. Additionally, these species are found on different

substrates; *S. ahmadiopsis* is collected on rotten woods or duff (Zhuang 2005, this work) and *S. superba* is found on sandy soil on the forest floor and along river beds (Schumacher 1990, Korf & Zhuang 1991, Yao & Spooner 1996, Hansen & Knudsen 2000). Based on microverrucose wall ornamentation, this species is somewhat similar to *S. kerguelensis*, but the latter species differs by longer marginal hairs (130–480 µm) and larger ascospores (21.8–28.2 × 14.4–21.8 µm).

**** Scutellinia badio-berbis*** (Berk. ex Cooke) Kuntze, Revis. Gen. Pl. 2: 869 (1891) (FIGS. 1 E-H)

APOTHECIA scattered to gregarious, sessile, discoid, 2–6(–10) mm diam, disc round or slightly undulate; hymenium orange when fresh, with a distinct margin covered by long and short hairs. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 25–75 µm diam, subhyaline, outermost cells mostly smaller, 15–30 µm wide. MEDULLARY EXCIPULUM of *textura intricata*, hyphae 12–18 µm wide, individual cells ca. 200 µm long, hyaline, thin-walled. SUBHYMENIUM of *textura prismatica*, individual cells 10–17.5 µm diam, hyaline, thin-walled. HAIRS clearly differentiated; marginal hairs stiff, brown to dark brown, of uneven length, 400–1600(–2000) µm long, (20–)30–50 µm wide, (5–)13–25 septate, thick-walled of (4–)5–8 µm, apex pointed or rarely blunt, with a bi-, tri- to multi-furcate rooting base; lateral hairs shorter than marginal hairs, less than 500 µm, paler brown than marginal hairs, apex pointed; hyphoid hairs hyaline, 1–2(–3) celled, less than 100 µm, with obtuse apex. ASCI cylindric, 8-spored, 180–260 × 13–15(–18) µm, about three fifths occupied with ascospores. ASCOSPORES ellipsoid, (16.0–)18.8–21.6(–24.0) (av. 20.2) µm long, (9.5–)11.0–12.4(–13) (av. 11.7) µm wide, l/w ratio (1.50–)1.65–1.85(–1.95) (av. 1.75), with slightly pointed ends, containing one or two large and several small internal guttules; wall ornamentation clearly pustulo-cristate; warts 1.2–3.0(–4.0) µm wide, 0.8–1.2(–2.4) µm high, most prominent and protruding around the poles, often connected to neighbouring ones, formed short ridges; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 4–5 septate, 2.5–3.5 µm wide, simple or branched at the base, slightly exceeding the asci; apical cell spadiciform, not sinuous, 5.5–10 µm wide, often shorter than the lower cells, (18–)24–40 µm long.

Specimens examined. SOUTH KOREA: Jeju, Seogwipo, a mushroom farm near Hallasan National Park, 14 Aug 2001 (KUS-F50134, 50145, 50149); Gangneung, Eoheul-ri, Daegwanryeong Recreational Forest, 5 Oct 2001 (50293); as above, 19 Oct 2001 (50376), as above, 6 Jun 2002 (50539); Juju, Seogwipo, Yeongsil, 13 Sept 2002 (50671, 50674, 50676); Hongcheon, near Yeonhwa Temple, 23 Sept 2005 (50885); Danyang, Youngbuwon-ri, Sobaeksan National Park, 20 Oct 2005 (50955); Yeongju, Sobaeksan National Park, Oknyeobong Recreational Forest, 21 Oct 2005 (50968); Hongcheon, near Yeonhwa Temple, 16 Jun 2006 (51101); Namyangju, Jinjeop-eup, Gwangneung, 12 Aug 2006 (51240).

Habitat. On damp rotting wood

Notes. This is the first record in Korea of *S. badio-berbis*, a tropical to subtropical species with worldwide distribution excluding Europe. The long marginal hairs and ellipsoidal ascospores with large, coarsely pustulo-cristate sculpturing characterize this species. The Korean materials showed a minor difference from the description of Schumacher (1990) in possessing somewhat smaller asci (180–260 × 13–15(–18) µm *vs.* 230–280 × 15–18.6 µm) and lower warts (0.8–1.2(–2.4) *vs.* up to 3.2 µm). Some earlier workers recorded slightly larger ascospores than we found and those reported by Schumacher (1990) of 18.2–23.2 × 9.6–13.2 µm, e.g. 22–28 × 14–17 µm by Le Gal (1953), 19.2–25 × 11–14.4 µm by Gamundí (1975) and av. 23.2 × 13.2 µm by Kullman (1982). Some of these measurements may include the height of warts that are about 2 µm high.

* ***Scutellinia colensoi*** Massee ex Le Gal, Bull. Soc. Mycol. Fr. 83: 356 (1967) (FIGS. 1 I-L)

APOTHECIA sessile, discoid, 2–5(–8) mm diam, disc round or slightly undulate, with a distinct margin covered with long, blackish hairs of uneven length; hymenium orange to red when fresh, but fading to brownish orange in dried specimens. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 25–120 µm diam, towards the margin elongated, hyaline to subhyaline. MEDULLARY EXCIPULUM of dense *textura intricata*, individual hyphae 5–12 µm wide. SUBHYMENIUM of densely packed mostly isodiametric cells, 5–10 µm wide. HAIRS clearly differentiated; marginal hairs stiff, brown to dark brown, uneven in length, 300–1700 µm long × 24–48 (av. 36) µm wide near the base, apex pointed, 10–20 septate, walls 3–5 µm thick, with a bi-, tri- to multi-furcate prominent base, individual rootlets relatively short and thin; lateral hairs shorter than marginal hairs, 120–350 µm, paler than marginal hairs, often flexuous, with a bifurcated or unbranched base, apex pointed or obtuse; hyphoid hairs mostly 2-celled, mostly less than 100 µm long, pale yellow or hyaline. ASCI cylindric, 8-spored, 180–240 × 10–15 µm, with a short base, apex rounded, about three fifths occupied by ascospores. ASCOSPORES ellipsoid, (16.0–)17.1–19.4(–20.0) (av. 18.3) µm × (9.5–)10.1–11.3(–12.0) (av. 10.7) µm, l/w ratio (1.50–)1.61–1.81(–2.00) (av. 1.71), with obtuse ends, containing one or two large internal guttules or several smaller ones; wall ornamentation clearly pustulo-cristate, warts large, up to 3.2 µm wide, up to 1.2 µm high, sometimes confluent to give a pseudo-reticulum; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 5–6 septate, 2.5–3.5 µm wide, simple or 1–2 times branched from midpoint, slightly exceeding the asci, containing orange pigment granules throughout when fresh; apical cell spadiciform, lanceolate or slightly enlarged towards tip, sinuous, irregular in width, only slightly wider than other cells, 4–7(–8) µm × (20–)30–50 (av. 40) µm.

Specimens examined. SOUTH KOREA: Pocheon, National Arboretum, 29 Aug 2002 (KUS-F50643); Dongducheon, Mt. Soyo, 6 Sept 2002 (50649, 50653, 50655, 50657).

Habitat. On damp rotting wood

Notes. The long marginal hairs and conspicuous pustulo-cristate ornamentation with large warts characterize this species. The asci of the Korean specimens are smaller than those given by Schumacher (1990) (210–280 × 14–19 µm), but are similar to other records: 180–230 × 11–15 µm from Zhuang & Wang (1998b) and 175–215 × 11–15 µm from Douanla-Meli & Langer (2005). Among the ten *Scutellinia* species with this type of wall sculpturing *S. colensoi* is most similar to *S. badio-berbis*. Other species with this type of wall ornamentation are: *S. badio-berbis*, *S. balansae*, *S. colensoi*, *S. cubensis*, *S. erinaceus*, *S. cejpii*, *S. geneospora*, *S. inexpectata*, *S. jungneri* and *S. nigrohirtula*. Previously, *S. badio-berbis* and *S. colensoi* often were confused because of their similar morphological characteristics, overlapping geographic distribution and their occurrence on damp rotting wood (Le Gal 1953, Gamundí 1975, Schumacher 1990), As a result, Kullman (1982) treated *S. colensoi* as a synonym of *S. badio-berbis*. In the present study, on the contrary, *S. badio-berbis* is clearly different from *S. colensoi* by its more massive and higher warts on the ascospores. This is in agreement with previous findings by Otani (1971), Moravec (1978) and Schumacher (1990). It is the case that the width of the warts was too similar to distinguish between the two species. Additionally, the ascospore dimension of *S. colensoi* (17.1–19.4 × 10.1–11.3 µm) are also somewhat smaller than that of *S. badio-berbis* (18.8–21.6 × 11.0–12.4 µm) and are similar to measurements given by Schumacher (1990), 17.2–20.3 × 9.8–11.6 µm *vs*. 18.2–23.2 × 9.6–13.2 µm. Le Gal (1953) and Schumacher (1990) say that *S. colensoi* has obtuse ellipsoidal spores rather than pointed ellipsoidal spores as in the latter species. In our study *S. badio-berbis* more often has pointed ellipsoidal spores than does *S. colensoi*, but these two ascospore shapes co-existed even in a single apothecium. Spore shape seems not to be a clear character to distinguish these species. The reports that *S. colensoi* has longer and thicker marginal hairs than *S. badio-berbis* (Le Gal 1953, Kullman 1982) could not be confirmed here since their size ranges varied according to specimens and often the measurements overlapped. Instead, we found that *S. colensoi* could be characterized by sinuous apical cells of paraphyses, which are also longer and narrower than those of *S. badio-berbis*. The height of warts on ascospores and shape of the apical cell of the paraphyses seem to be the most useful to differentiate the two species; these differences were constantly found among many specimens. Previously the morphology of paraphyses was not considered to be relevant for species delimitation of the *Scutellinia*. As a result, many morphological investigations have provided only the width and shape of apical cells without attributing any taxonomic value. However, the present study highlights the potential taxonomic importance of this character, which thus should be observed carefully and characteristics should be reported in species descriptions.

Scutellinia colensoi is widely distributed in subtropical to warm temperate regions. This is the first record from Korea. It seems to be widely distributed in Asian countries, including Japan,

Pakistan, Thailand (Schumacher 1990), China (Zhuang & Wang 1998a), and Russia (Bogacheva & Kullman 2006) but has not been reported from North America.

Scutellinia jejuensis J.G.Han, Y.J.Choi, H.D.Shin, Mycotaxon 112: 48 (2010)

For a description of this recently described species the original publication (Han et al. 2010) should be consulted.

Specimen examined. SOUTH KOREA: Jeju, Hallasan National Park, near Mulchat-oreum, 5 Nov 2008 (KUS-F52411).

Habitat. on shaded, damp soil

Notes. Han et al. (2010) introduced this species that has subglobose to globose ascospores and aculeolate-reticulate ornamentation. Most of the *Scutellinia* species in Asia have ellipsoid spores (Otani 1971, Kaushal et al. 1983, Zhuang 1989, 1994, 1997, 1998); this is the only species with subglobose spores so far collected in South Korea. *Scutellinia jejuensis* and *S. sinensis* M.H.Liu from China (Liu & Peng 1996) are the confirmed species with subglobose to globose spores in Asia.

**** Scutellinia jilinensis*** Z.H.Yu & W.Y.Zhuang, Mycotaxon 75: 404 (2000)

APOTHECIA scattered to gregarious, sessile, discoid, 1.5–6(–8) mm diam, disc round or slightly undulate, with a distinct margin covered by long marginal hairs; hymenium orange to red when fresh but often brown in dried specimens. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 30–70 µm diam, subhyaline to pale yellow, outermost cells mostly smaller and longer, 15–30 µm wide. MEDULLARY EXCIPULUM of *textura intricata*. SUBHYMENIUM of *textura prismatica*, individual cells 10–20 µm diam, hyaline, thin-walled. HAIRS clearly differentiated; marginal hairs stiff, brown to dark brown, of uneven length, 300–1600 µm long, (20–)30–50 µm wide, 3–8(–13) septate, thick walls, (4–)5–8 µm, apex pointed or rarely blunt, with a (bi-)tri- to multifurcate rooting base; lateral hairs shorter than marginal hairs, mostly 150–360 µm, paler brown than marginal hairs, with a simple or bifurcate rooting base, apex pointed; hyphoid hairs hyaline to pale yellow, 1–2-celled, less than 100 µm long, 14–23 µm wide. ASCI cylindric, 8–spored, 200–280 × 12–18 µm, apex mostly rounded, about three fifths occupied with ascospores. ASCOSPORES broadly ellipsoid to ellipsoid, (14–)15.6–18.0(–21) (av. 16.8) µm long, (10–)10.2–11.6(–12) (av. 10.9) µm wide, excluding the height of warts, l/w ratio (1.40–)1.47–1.64(–1.80) (av. 1.55), containing mostly one large but rarely two or several small internal guttules; wall ornamentation pustulo-cristate or partially reticulated; warts large, variable in size and shape, 1–2.5(–3.5) µm wide, 0.8–1.2(–1.5) µm high, isolated or confluent, often forming short ridges to give a pseudoreticulate pattern; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 4–5 septate, 2.5–4.0 µm wide, simple or branched at the

base, slightly exceeding the asci; apical cell enlarged to (6–)8–11 µm wide, irregular in width, often shorter than the cells below, 16–35 µm long.

Specimens examined. SOUTH KOREA: Gangneung, Eoheul-ri, 1 Jul 2002 (KUS-F50576); Dongducheon, Mt. Soyo, 6 Sept 2002 (50659); Jeju, Seogwipo, Yeongsil, 13 Oct 2002 (50675).

Habitat. On damp rotting wood

Notes. The three Korean collections listed here are close to *S. badio-berbis* having long marginal hairs, broadly ellipsoid ascospores with pustulo-cristate or partially reticulate ornamentation, but they have smaller ascospores (15.6–18.0 × 10.2–11.6 *vs.* 18.8–21.6 × 11.0–12.4 µm) than that species. Five *Scutellinia* species have similar morphological characteristics to specimens referred here to *S. jilinensis*. *Scutellinia chiangmaiensis* T.Schumach. and *S. cubensis* have broader ascospores (15.3–18.0 × 11.0–13.0 and 15.6–18.5 × 11.2–14.4 µm) and shorter marginal hair (up to 950 and 600–1100 µm) (Schumacher 1990); *S. pennsylvanica* is distinguished by more conspicuous reticulate pattern on ascospore walls and somewhat larger ascospores (16.2–22.8 × 11.2–13.6 µm) (Schumacher 1990). The wall ornamentation and size of ascospores are close to *S. fujianensis* J.Z.Cao &J.Moravec (Cao & Moravec 1988), but the latter species differs from the present specimens in its shorter and narrower marginal hairs of 130–540(–700) × 10–27 µm, higher warts of 2–3.7(–4.5) µm and in its occurrence on soil. The morphological characteristics of the present species agree well with *S. jilinensis* (Yu et al. 2000), although its ascospores are slight broader (10.2–11.6 *vs.* 10–12.7 µm) and the warts are more interconnected. *Scutellinia jilinensis* was originally recorded from the Changbai Mountains, also known as the Baekdu Mountains in Korea, on the border between North Korea and China. It was also collected on rotting woods like the Korean specimens. This is the first record of it from Korea, and it seems to be distributed widely in East Asia, as referred to by Zhuang (2005).

* ***Scutellinia nigrohirtula*** (Svrček) Le Gal, Bull. Soc. Mycol. Fr. 80: 123 (1964)

APOTHECIA sessile, discoid, 3–10(–15) mm diam, disc round or undulate, with a distinct margin densely clothed with dark brown hairs; hymenium reddish to orange when fresh. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 30–100 µm diam, towards the margin elongated. MEDULLARY EXCIPULUM of *textura intricata*, hyphae 6–12 µm wide, hyaline, thin-walled. SUBHYMENIUM of densely packed, angular, short-celled hyphae. HAIRS not differentiated; marginal hairs stiff, mostly straight but rarely slightly flexuous, ventricose, brown to pale brown, 200–420 µm long, 18–30 µm wide, apex pointed or rarely obtuse, 3–6 septate, thick-walled of up to 8 µm, with a simple or bifurcate base; lateral hairs shorter than marginal hairs, often flexuous, apex pointed or rarely obtuse, with mostly unbranched rooting bases; hyphoid hairs were observed. ASCI cylindric, hyaline, 8-spored, (160–)200–260 × 18–23(–28) µm, apex slightly rounded, about two thirds occupied with ascospores. ASCOSPORES hyaline, ellipsoid to broadly ellipsoidal, (20.0–)21.7–26.3(–29.0) (av. 24.0) µm long, (13.5–)14.2–16.0(–

16.5) (av. 15.1) µm wide, l/w ratio (1.35–)1.46–1.67(–1.80) (av. 1.57), containing one or two large guttules; wall ornamentation verrucose or low pustulo-cristate, composed of small warts, irregularly distributed, often confluent and forming sinuate line, commonly 0.4–0.8 µm wide but when interconnected up to 1.5 µm, less than 0.4 µm high; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 5–6 septate, 3–4 µm wide, simple or sometimes branched below, slightly exceeding the asci; apical cell clavate, enlarged to 8–12 µm wide, 30–40 µm long.

Specimen examined. SOUTH KOREA: Gangneung, Eoheul-ri, 19 Oct 2001 (KUS-F50377); as above, 1 Jul 2002 (50584).

Habitat. On damp rotting woods

Notes. This is the first record of this species from Korea. The undifferentiated short marginal hairs and ellipsoidal to broadly ellipsoidal ascospores with verrucose ornamentation are in agreement with *S. nigrohirtula* as described by Gamundí (1975), Hirsch (1985) and Schumacher (1990). The short hairs and large ascospores of *S. nigrohirtula* are most like *S. kerguelensis*, but it is easily distinguishable by a higher l/w ratio of ascospores and somewhat visible spore sculpturing in profile. *S. nigrohirtula* has ellipsoid ascospores up to 17 µm wide (13.8–16.6 µm in Schumacher (1990), 14–17 µm in Zhuang (1994) and 14–16.5 µm in Hansen & Knudsen (2000)), while *S. kerguelensis* has broadly ellipsoid to subglobose spores up to 20–22 µm (Schumacher 1979, 1990, Yao & Spooner 1996, Hansen & Knudsen 2000). *Scutellinia nigrohirtula* is often found in boreo-temperate regions of Europe and South America (Schumacher 1990). The records from Japan (Schumacher 1990) and China (Zhuang 1994, Zhuang & Yang 2008), as well as Korea (this study) indicate that this species is also commonly distributed in Asia.

* ***Scutellinia aff. olivascens*** (Cooke) Kuntze, Rev. Gen. Pl. 2: 869 (1891) (FIGS. 1 M-P)

APOTHECIA sessile, 3–10(–20) mm diam, discoid, disc round or irregular undulate, with a distinct margin covered by short blackish brown hairs; hymenium orange to red when fresh. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 30–110 µm diam. MEDULLARY EXCIPULUM of *textura intricata*, hyphae 5–8(–11) µm wide, hyaline. SUBHYMENIUM indistinct. HAIRS not differentiated, stiff, densely crowded, brown, 180–480(–850) µm long, 12–30(–35) µm wide, 3–10 septate, with walls 3–5 µm thick, apex pointed or obtuse, base bi- or trifurcate, distinct, mostly unforked, deeply rooting. ASCI hyaline, cylindric, 8-spored, 200–280 × 14–20 µm, apex slightly flattened, about three fifths occupied with ascospores. ASCOSPORES ellipsoid, with slightly narrow ends, (20.0–)21.2–24.5(–27.5) (av. 22.8) µm long, (12.0–)12.5–14.5(–16.0) (av. 13.5) µm wide, l/w ratio (1.45–)1.62–1.83(–2.00) (av. 1.73), containing mostly one or two large but rarely numerous small guttules; wall ornamentation low and irregularly verrucose or pustulo-cristate; warts irregularly distributed, often confluent and merged, forming

crests, variable in shape and size, 0.4–1.0 µm wide, 0.4–0.6(–1.0) µm high; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 5–6 septate, 2.5–4 µm wide, simple or branched at the base, slightly exceeding the asci; apical cell enlarged, clearly clavate, 40–55 µm long, 8–10(–12) µm wide.

Specimens examined. SOUTH KOREA: Pyeongchang, Yongpyeong-myeon, Mt. Gaebang, 11 Jul 2002 (KUS-F50624, 50627); Hoengseong, Mt. Cheongtae, 11 Jul 2002 (50625); Hongcheon, near Yeonhwa Temple, 11 Jun 2007 (51627).

Habitat. On damp rotting wood

Notes. This is the first record of *S. olivascens* in Korea. The short hairs and large ascospores are similar to *S. nigrohirtula* and *S. kerguelensis*, although it has a higher l/w ratio of ascospores. Additionally, *S. olivascens* is easily distinguished from these two species by the possession of rare longer hairs (up to 850 µm) and somewhat more visible spore sculpturing. Schumacher (1990) and Hansen & Knudsen (2000) noted that broad marginal hairs to 45–50 µm could characterize this species, but the Korean specimens showed narrower ones (up to 35 µm). This range fits well with the descriptions of *S. ampullacea* and *S. lusatiae*, which were synonymised under *S. olivascens* by Schumacher (1990); for the former species 22–36 µm (Le Gal 1966) and 18–36 µm (Schumacher 1979) and for the latter species 19–26 µm (Gamundí 1956).

* ***Scutellinia orientalis***, Y.J.Choi, H.D.Shin & Pfister, **sp. nov.** (FIGS. 2)

MycoBank MB 801278

Etymology. This name refers to biogeographical region, Korea and possibly China and Mongolia where the fungus was collected.

APOTHECIA gregarious to scattered, sessile, discoid, 2–5(–7) mm diam, disc rounded or slightly undulated with a distinct margin covered by blackish brown hairs which are stretched inward and outward, hymenium orange to reddish orange. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 30–150 µm diam, hyaline to subhyaline. MEDULLARY EXCIPULUM of *textura intricata*, hyaline, thin-walled. SUBHYMENIUM of *textura prismatica*. HAIRS slightly differentiated; marginal hairs stiff, brown to dark brown, of uneven length of (280–)480–1000(–1500) µm long, 20–35(–42) µm wide, broader at base, thick-walled, 7.5–10 µm, 11–20(–32) septate, apex pointed, with a bi-, tri- to multifurcate base; lateral hairs shorter, 140–300 µm long, 15–20 µm wide, mostly straight, apex pointed, with mostly bifurcate, but rarely unbranched or trifurcate rooting base. ASCI cylindric, 8-spored, apex slightly flattened, 180–220 × 13–18 µm, about two thirds occupied with ascospores. ASCOSPORES broadly ellipsoid to ellipsoid, (16–)16.9–19.3(–21) (av. 18.1) µm long, (10.5–)11.4–12.6(–13.0) (av. 12.0) µm wide, l/w ratio (1.35–)1.44–1.58(–1.65) (av. 1.51), containing a single large or several small internal guttules; wall ornamentation tuberculate; warts irregularly and densely distributed on the surface, 0.3–0.8 µm wide, 0.2–0.4(–0.6) µm high, rounded, isolated but often inter-connected between

neighboured ones, especially in immature spores. PARAPHYSES filiform, straight, hyaline, 2.5–4 µm wide, 5–6 septate, simple or branched at the base, exceptionally branched in upper part; apical cell clavate, 26–54 µm long, 6.5–9 µm wide.

Holotype. SOUTH KOREA, Pocheon, National Arboretum, on damp rotting wood, 27 Sept 2001, Y.J. Choi & H.D. Shin (KUS-F50264)

Specimens examined. As above, 29 Aug 2002, Y.J. Choi & H.D. Shin (KUS-F50641).

Habitat. On damp rotten wood

Notes. Regarding the tuberculate wall ornamentation of ascospores and uneven length of marginal hairs, this species is most close to *S. subhirtella* Svr
ek and *S. patagonica*. By having much longer and wider marginal hairs with more septa (FIG. 2 C&D) and multi-rooted base (FIG. 2 E) the Korea specimens of *S. orientalis* can be easily differentiated from these two species based on the marginal hairs of 150–600 × 15–30 µm (Svrček 1971) and 200–1050 × 15–48 µm (Schumacher 1990), respectively. Additionally, the ascospores are somewhat smaller, and the warts are more often connected (FIG. 2 F-J; see Fig. 1. S&T for *S. patagonica*). Substrate differences also offer evidence for discriminating between *S. subhirtella* and the present species. *Scutellinia subhirtella* is mostly found on humid soil or very rarely on plant or surrounding wood debris (Schumacher 1979, 1990, Hansen & Knudsen 2000), but the collections of *S. orientalis* were made on damp wood, that was not in direct contact with the soil. Sequence comparisons show that *S. orientalis* and two specimens of *S. subhirtella* from Europe are phylogenetically distant thus adding support for the recognition of this species. The specimens used by us in phylogenetic comparisons and identified as *S. subhirtella* were those included in Perry et al. (2007) and one that was from TAAM redetermined by us as *S. subhirtella*.

In China and Mongolia, a few studies (Zhuang 1994, 1997, Zhuang & Wang 1998b, Yu et al. 2000) found several *S. subhirtella*-like specimens occurring on the rotten wood. Interestingly, Zhuang (1994) and Yu et al. (2000) also noted that some specimens possess exceptionally long marginal hairs (up to 1600 µm), that are much longer than other *Scutellinia* species with tuberculated ascospores and those of *S. subhirtella*, but are similar to *S. orientalis*. Yu et al. (2000) temporarily treated it as *S.* cfr. *subhirtella*. The Chinese and Mongolian collections seem to be identical to those from Korea.

* ***Scutellinia aff. patagonica*** (Rehm) Gamundí, Lilloa 30: 318 (1960) (FIGS. 1 Q-T)

APOTHECIA scattered to gregarious, sessile, discoid, 3–8(–14) mm diam, disc round or slightly undulate, with a distinct margin densely clothed by blackish brown hairs of uneven length; hymenium orange or reddish orange when fresh. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, individual cells 45–130 µm diam, towards the margin elongated, outer most cells up to 35 µm with hyaline walls. MEDULLARY EXCIPULUM of densely interwoven *textura*

intricata, hyphae 6–9 µm wide, hyaline, thin-walled. SUBHYMENIUM of dense *textura prismatica*. HAIRS not or slightly differentiated; marginal hairs stiff or slightly flexuous, ventricose to broad at base, dark brown to brown, uneven 150–800(–1000) µm long, 20–40(–45) µm wide, apex pointed or rarely blunt, 1–6 septate, thick-walled of 3.5–6 µm, with mostly a bifurcate, prominent deeply rooting base; lateral hairs shorter than marginal hairs, 80–150(–300) µm, ventricose, flexuous, 16–28 µm wide, apex pointed or rarely blunt, with mostly unbranched but rarely bifurcate bases. ASCI cylindric, 8-spored, (190–)220–260 × (14–)16–20 µm, apex rounded, about three fifths occupied with ascospores. ASCOSPORES ellipsoid to broadly ellipsoid, (17.5–)18.7–21.3(–23.5) (av. 20) µm long, (11–)11.6–13.5(–14.5) (av. 12.8) µm wide, l/w ratio (1.35–)1.50–1.67(–1.75) (av. 1.59), containing 1–2 large or several small guttules; wall ornamentation tuberculate; warts evenly distributed on the spore surface but variable in size 0.4–1.0(–2.0) µm wide, 0.2–1.2 µm high, mostly isolated but rarely connected between neighboured ones when ascospores are collapsed; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 5–6 septate, 3–4 µm wide, containing orange or yellowish orange pigment granules throughout when fresh, simple or sometimes branched below, slightly exceeding the asci; apical cell clavate, 20–46 µm long, 7–10 µm wide.

Specimens examined. SOUTH KOREA: Donghae, Cheongok-dong, near Donghae Gymnasium, 29 Aug 2001 (KUS-F50193); *as above*, 20 Oct 2001 (50383); *as above*, 7 Jun 2002 (50547); *as above*, 30 Aug 2002 (50646); Chungju, Sangmo-myon, 13 Jun 2002 (50558).

Habitat. On mostly humid soil but very rarely on rotten wood in areas of fruiting.

Notes. Scutellinia patagonica is mainly recognized by medium sized rooting hairs, broadly ellipsoidal ascospores, distinctly tuberculate ornamentation and rounded to angular warts on the ascospore wall surface (Schumacher 1979 1990). Morphological characteristics of the Korean specimens are mostly in agreement with other descriptions of this species, but the ascospores (av. 12.8 µm) are somewhat narrower, 13.4–18.5 µm in Schumacher (1990), 14.4–18.6 µm in (Gamundí 1975) and 13.8–18.5 µm in Hansen & Knudsen (2000). The ellipsoidal ascospores are the most close in size to those of *S. subhirtella,* another tuberculate- walled species. The spores of that species are 12–14(–15) µm wide in Svrček (1971) and 12.0–14.8 µm in Schumacher (1990). Variable sized warts (generally 0.8 µm, but occasionally 2.0 µm wide), a typical character of *S. patagonica*, were often observed in the Korean specimens (see Fig. 1. S & T). This is quite different than *S. subhirtella* that has even small warts usually less than 1.2 µm wide. The Korean specimens might be treated an undescribed species, but we treat it here as a member of a complex of taxa around *S. patagonica*. Our expanded molecular phylogenetic study of *Scutellinia* world-wide (in prep.) included specimens identified as *S. patagonica* by Schumacher. The collections reported here from Korea are most close to those collections. The exact identities of these taxa remain to be fully resolved.

Scutellinia scutellata (L.) Lambotte, Fl. Mycol. Belge, Suppl. 1: 299 (1887) (FIGS. 1 U-X)

APOTHECIA scattered to gregarious, sessile, 2–10(–17) mm diam, discoid or slightly concave with a distinct margin, disc mostly round but sometimes undulate at the margin, densely covered with brownish black hairs of uneven length; hymenium orange or reddish orange when fresh. ECTAL EXCIPULUM of *textura globulosa* to *textura angularis*, cells 20–95 µm diam, toward the margin and in the outermost excipulum becoming elongated and clavate with hyaline to subhyaline walls. MEDULLARY EXCIPULUM of dense *textura intricata*, cells 5–13 µm wide, hyaline, thin-walled. SUBHYMENIUM indistinct. HAIRS clearly differentiated; marginal hairs stiff, rarely bent, brown to dark brown, of uneven length, 400–1000(–1800) µm long, 22–45 µm wide, broader toward the base, apex pointed or rarely blunt, 8–15(–24) septate, thick-walled of 3.5–7.5 µm, with mostly a bi- or trifurcate base; lateral hairs shorter than marginal hairs, flexuous, paler brown or hyaline, 100–560 µm long, 12–26 µm wide, often constricted at the septa, apex pointed or sometimes blunt, base mostly unbranched but rarely bi-trifurcate; superficial hairs interspersed among the marginal hairs, variable in shape, clavate or bulbous, pale yellowish to hyaline, 30–100 µm long, 0–2 septate, apex rounded, with simple base. ASCI cylindric, 8-spored, (160–)200–240 × 12–15(–18) µm, apex somewhat flattened, about two thirds occupied with ascospores. ASCOSPORES ellipsoid, variable in shape and size, (16.5–)17.4–20.2(–24) (av. 18.8) µm long, (10.4–)10.7–12.2(–14) (av. 11.5) µm wide, l/w ratio (1.45–)1.53–1.70(–1.75) (av. 1.62), with obtuse to pointed ends, containing one or two large or several small guttules; spore sculpturing composed of minute verrucose warts, 0.2–0.8(–1.2) µm wide, mostly less than 0.5 µm high, often confluent, forming an incomplete reticulate; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 5–6 septate, 2.5–3 µm wide, containing orange or yellowish orange pigment granules throughout when fresh, simple or rarely branched at the base, slightly exceeding the asci; apical cell clavate, 7–10 µm wide, generally shorter than cells below, (16–)25–40 µm long.

Specimens examined. SOUTH KOREA: Gangneung, Eoheul-ri, Daegwanryeong Recreational Forest, 6 Jun 2002 (KUS-F 50543); Gangneung, Eoheul-ri, 1 Jul 2002 (50577, 50580, 50590); Pocheon, National Arboretum, 24 Jun 2002 (50394); as above, 8 May 2002 (50494); *as above*, 4 Jul 2002 (50602); Nonsan, Gyeryongsan National Park, near Gab Temple, 17 May 2002 (50519); Wonju, Chiaksan Natioanl Park, 3 Jun 2002 (50521, 50522, 50523); as above, 27 Aug 2004 (50722); as above, 30 Sept 2005 (50902); Pyeongchang, Korean Botanic Garden, 6 Jun 2002 (50533); Pyeongchang, Yongpyeong-myeon, Mt. Gaebang, 11 Jul 2002 (50604, 50626); Gangneung, Eoheul-ri, 6 Jun 2002 (50542); as above, 6 Jun 2002 (50546); *as above*, 1 Jul 2002 (50579, 50581, 50591, 50592); Gangneung, Eoheul-ri, Daegwanryeong Recreational Forest, 7 Jun 2002 (50548); Hongcheon, Hwajeon-ri, 24 Sept 2005 (50893); Hoengseong, Hoengseong Recreational Forest, 22 Jun 2006 (51122); Inje, Seoraksan National Park, near Baekdam Temple, 28 Sept 2006 (51405); Chuncheon, Goeun-ri, 11 Nov 2005 (50976).

Habitat. on damp rotting wood

Notes. Lee & Cho (1975) and Jung (1995) previously recorded this species in Korea. The long marginal hairs and the small ellipsoidal ascospores with verrucose ornamentation characterize this species. The morphological characteristics, geographic distribution and substrates are too similar to *S. crinita* to separate them by the species boundaries of Schumacher (1990). Previously, the species delimitation has been highly controversial among various authors (Denison 1959, Le Gal 1966, Svrček 1971, Moravec 1978, Kullman 1982, Schumacher 1990, Korf & Zhuang 1991, Zhuang 1994). Later Yao & Spooner (1996) suggested that *S. crinita* should be considered a synonym of *S. scutellata*. In the Korean collections, the ascospores with broadly rounded ends or slightly pointed ends were simultaneously observed in a single apothecium, although it believed that this character serves to differentiate *S. scutellata* and *S. crinita*.

Among about a hundred collections examined, 31 specimens are morphologically similar to *S. scutellata*, suggesting it is evidently common all over South Korea, but within them, an infraspecific morphological variation was found. Five specimens (50543, 50577, 50580, 50590, 50626) possess many superficial brown to yellowish hairs and thick wall of 3.5–4 μm, but in remaining specimens such hairs are rarely present and walls are thin, less than 2 μm. Also, under the light microscope, somewhat higher warts of ascospores could be also discerned the five collections from other specimens with minutely warted ascospores. Interestingly, a specimen KUS-F50519, has remarkably large apothecia of 5–12(–20) mm diam, although other morphological characteristics agree with *S. scutellata*. We treat all Korean specimens at least temporarily as members of the *S. scutellata* complex.

* ***Scutellinia setosa*** (Nees) Kuntze, Rev. Gen. Pl. 2: 869 (1891)

APOTHECIA sessile, gregarious, discoid, 1–2(–3) mm diam, disc round, with an indistinct margin covered by short, dark brown hairs; hymenium light orange to yellowish when fresh. ECTAL EXCIPULUM of *textura globulosa* to *angularis*, individual cells 20–80 μm diam, hyaline to subhyaline, elongated toward the margin. MEDULLARY EXCIPULUM of *textura intricata*, hyaline. SUBHYMENIUM thin, distinct. HAIRS not differentiated, densely crowded, mostly straight, brown to dark brown, (200–)400–800(–1000) μm long, 18–32 μm wide, 3–6 septate, thick-walled of 4.5–7(–8) μm, apex pointed or sometimes obtuse, with a bi- to multi-furcate base. ASCI hyaline, cylindric, 8–spored, 130–230 × (10–)12–16 μm, apex rounded, with short base. ASCOSPORES ellipsoid to oblong, (17.0–)18.1–20(–22) (av. 19.1) μm long, (9–)10.0–12.1(–13.5) (av. 11.1) μm wide, l/w ratio (1.50–)1.60–1.75(–1.80) (av. 1.67), containing many small guttules; ascospore walls smooth; wall not loosening in heated lactic acid. PARAPHYSES filiform, straight, hyaline, 4–6 septate, 2–3 μm wide, not or branched 1–2 times in lower part, even or slightly longer than the asci; apical cell very slightly clavate, 4–7(–8) μm wide, 30–52 μm long.

Specimen examined. SOUTH KOREA: Gangneung, Eoheul-ri, 19 Oct 2001 (KUS-F50363).

Habitat. On damp rotting wood

Notes. This species is easily recognized by small apothecia gregariously distributed on damp rotting wood and the smooth ascospore walls. The Korean specimen is well in agreement with a description of *S. setosa* by Schumacher (1990). This species was often regarded to be identical with *S. erinaceus* (Schwein.) Kuntze or *S. setosissima* LeGal. Earlier authors (Denison 1959, Svrček 1971, 1981) wrongly used the name *S. erinaceus* for the specimens with smooth ascospores, possibly representing *S. setosa*, as LeGal (1966, 1968) and Schumacher (1990) pointed out that *S. erinaceus* has a coarsely verrucose-spored taxon. *Scutellinia setosissima* appears smooth under optic microscopy, but this species indeed has minutely verrucose ascospores when they are observed under SEM (Schumacher 1990).

During studies between 2001 and 2008, this species only was collected once; thus, it seems to be rare in Korea. The presence of *S. setosa* in Asian regions has not been confirmed. When Zhuang (1994) examined the specimens referred to this species collected from China, she found it to be different than *S. setosa* s.str. from North America because of the minute makings on ascospore surface. The collections were later treated as a new species, *S. sinosetosa* (Zhuang & Wang 1998b). To verify our identification, a sequence comparison of rDNA was performed to compare the Korean and North American specimens. This has supported the identity of the Korean specimens as *S. setosa*. Therefore, this is considered new to Asia.

Key to the species of the genus *Scutellinia* in Korea

1. Ascospores with smooth wall……..……..... *S. setosa*
1. Ascospores with visible wall ornamentation …….…… 2
2. Ascospores subglobose to globose, with aculeolate-reticulate ornamentation ... *S. jejuensis*
2. Ascospores ellipsoidal to broadly ellipsoidal, with confluent or tuberculate ornamentation 3
3. Marginal hairs often more than 800 µm long, differentiated from lateral hairs .....… 4
3. Marginal hairs less than 800 µm long, not differentiated from lateral hairs ……..….... 7
4. Wall ornamentation tuberculate; warts mostly isolated but rarely interconnected ….. *S. orientalis*
4. Wall ornamentation verrucose or pustule-cristate, warts often confluent …….. 5
5. Warts on wall surface less than 1.2 µm high ……..…….. *S. scutellata* complex
5. Warts on wall surface more than 1.2 µm high ……..……..... 6
6. Ascospores broadly ellipsoidal, less than 18 x 11 µm; warts more often confluent …. *S. jilinensis*
6. Ascospores ellipsoidal, more than 18 x 11 µm …….....….. 8

7. Ascospores av. 20.2 x 11.7 µm; warts often more than 1.2 µm high; apical cell of paraphyses spadiceiform and uniform in width ……..……...…..... *S. badio-berbis*

7. Ascospores av. 18.3 x 10.7 µm; warts mostly less than 1.2 µm high; apical cell of paraphyses sinuous and not enlarged .....……...….. *S. colensoi*

8. Marginal hairs mostly 400–800 µm ……... 9

8. Marginal hairs less than 400 µm ….…….…….... 10

9. Wall ornamentation tuberculate; warts rounded, isolated ……. *S. aff. patagonica*

9. Wall ornamentation verrucose; warts variable in shape, often confluent …….. *S. aff. olivascens*

10. Marginal hairs mostly less than 300 µm; ascospores less than 22 µm long ..…... *S. ahmadiopsis*

10. Marginal hairs often longer than 300 µm; ascospores more than 22 µm long ….... *S. nigrohirtula*

Excluded species and questionable records

Scutellinia erinaceus (Schwein.) Kuntze, Rev. Gen. Pl. 2: 869 (1891)

Cho & Lee (2002) recorded this species for the first time in Korea, but the record is questionable. They did not describe the wall ornamentation of the ascospores, one of the most important features for species delimitation in *Scutellinia*. Besides, the diameter of apothecia, size and shape of ascospores and occurrence on wood are more similar to those characters as described for *S. setosa* than for *S. erinaceus*. Schumacher (1990) describes *S. erinaceus* with apothecia of 5–6 mm diam, 2–3 mm wider than in the Korean material. The ascospore size (19.1–24.6 x 13.0–16.8 µm) of *S. erinaceus* is also clearly larger than those from Korea (17.5–20 x 10–12.5 µm). In addition, this species has been found only in USA (Schumacher 1990), and the specimens reported from China of *S. erinaceus* were indeed morphologically near to *S. subhirtella* (see Zhuang 1994).

Scutellinia kerguelensis (Berk.) Kuntze, Rev. Gen. Pl. 2: 869 (1891)

Previously Park *et al*. (1994) and Jung (1995) recorded this species with significantly smaller ascospores (17.5–20 x 11–12.5 µm and 18–24.5 x 11–13.5 µm, respectively) than described by Schumacher (1990) (21.8–28.2 x 14.4–21.8 µm). Interestingly, Zhuang (1994, 2005) noted that *S. kerguelensis* from China has smaller ascospores (19–24 x 12–15 µm), for which a new variety, *S. kerguelensis* var. *microspora*, was introduced (Zhuang 2005). Morphological characteristics of the Korean specimens of *S. kerguelensis* (Park *et al*. 1994, Jung 1995) agree well with the description of the new variety. The variety was found in China (Zhuang & Korf 1989, Zhuang

1994, 2005) and similarly *S. kerguelensis* reported from India (Waraitch 1977) also has smaller ascospres of 17.5–20.5 x 10–13 µm. This suggest that this variety might be common in Asia countries.

Scutellinia umbrorum (Fr.) Lambotte, Fl. Mycol. Belge, Suppl. 1: 300 (1887)

This species has been reported just once in Korea by Cho et al. (1997). But, the small ascospores of 16–19 x 11–12 µm reported and fine wall ornamentation differ from those of *S. umbrorum* (16.8–25.2 x 12.7–17.2 µm and clearly tuberculate) (see Schumacher 1979, 1990). Moreover, this species was mainly found on soil and geographically is limited to Europe, but the Korean specimen was collected from wet rotten wood.

Scutellinia pseudoumbrarum J. Moravec, Česká Mykol. 25: 199 (1971)

This species is now considered a synonym of *S. umbrorum* (Schumacher 1990). Cho et al. (1997) recorded *S. pseudoumbrarum* for the first time in Korea, but their identification is questionable. In their line drawing, the ascospores possess aculeolate-reticulate wall sculpturing, while both *S. pseudoumbrarum* and *S. umbrorum* have remarkably tuberculated spores (Moravec 1971, Kullman 1982, Schumacher 1990). The description of Cho et al. (1997) suggests that their fungus is more similar to another Korean species, *S. jejuensis* (Han et al. 2010), in possessing aculeolate-reticulate ascospore ornamentation and it occurrance on soil in the southern regions of Korea.

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FIGURE CAPTIONS

Fig. 1. Ascomata and ascospores (SEM) of *Scutellinia* species recognized in Korea. A–D: *S. ahmadiopsis*, E–H: *S. badio-berbis*, I–L: *S. colensoi*, M–P: *S. aff. olivascens*, Q–T: *S.* aff. *patagonica*, U–X: *S. scutellata*. First and second column: ascomata, third and fourth columns: ascospores (scale bar = 10 µm).

Fig. 2. *Scutellinia orientalis* (KUS-F50264 - holotype). A–B: fresh apothecia on damp wood, C: dried apothecia with long marginal hairs, D: marginal and lateral hairs, E: multi-furcated base of marginal hairs. F–H: broadly ellipsoidal to ellipsoidal ascospores sculpturing tuberculate ornamentations stained on Cotton Blue in lactic acid, note on mostly isolated but rarely interconnected tubercles, F–H: ascospores in SEM. Scale bars = 5 mm for A–C, 500 µm for D, 20 µm for E, and 10 µm for F–J.